FÉDÉRATION AÉRONAUTIQUE INTERNATIONALE

AEROBATIC CATALOGUE

Adopted by the FAI Aerobatics Commission (CIVA), 1987

Second Edition

FAI AEROBATIC CATALOGUE
INTRODUCTION

To all who use this new aerobatic catalogue in the name of the Federation Aeronautique Internationale, I wish joyous flying and great good luck with success in competitions. The aerobatic discipline is one of the FAI's earliest aeronautical endeavours. This new book, based on the great Spanish aerobatist Colonel Aresti's original concepts, now reflects the best possible input from the top people in the sport and its premier FAI administrations in the world. To quote a saying often heard in my own country, "The cost of freedom is eternal vigilance", this sums up the FAI attitude toward aerobatic pilots – so keep it safe and do not open areas for government and other authority to impose restrictions on us in this adventurous but essentially safe sport.

Again, great success to all who use this book and operate under the FAI aegis.

G. A. Lloyd
President
Federation Aeronautique Internationale

Sydney, Australia
December 1987

The sport of competition aerobatics, under the banner of the Federation Aeronautique Internationale, brings men and women together in spirited contests to pit their skills against each other in their attempts to fly the perfect aerobatic sequence. No such sequence has yet been flown, but down through the years, the sport has seen many outstanding men and women pilots who have devoted many hours and years perfecting their skills while they reach for that plateau of perfection. The FAI Aerobatic Catalogue is their common language. No matter what tongue they might speak, the figures depicted in this book are their common base. Without it, aerobatic competition would not be possible. It is appropriate, therefore, to pay tribute to the many people who have made this catalogue possible and, most certainly Señor José L. Aresti comes at the top of this list. His decades of dedication and involvement in the sport are well known. In addition, all the members of the FAI Aerobatics Commission's sub-committee on the catalogue deserve thanks. Since aerobatics has been in existence, there have been pioneers of a short-hand system of diagramming aerobatic figures. Their contributions, therefore, have also been very important.

I join Mr. Lloyd in wishing all of the aerobatic pilots throughout the world good luck in competition and safe flying always.

Michael R. Heuer
President
FAI Aerobatic Commission (CIVA)

Cordova, Tennessee, USA
December 1987

This coming new year, 1999, sees two major changes in the now well-established FAI Aerobatic Catalogue. One of these is the first significant departure from the way the catalogue was first originally conceived, and sees the removal of spins from Family 4 to Family 9. Treating the spin auto-rotation in the same way as aileron and flick rolls will open up a whole new avenue of imaginative sequence construction. The second major change is in the way the catalogue is compiled and distributed: electronically. Advances in Information Technology since the catalogue's introduction just 11 years ago, particularly personal computing and the Internet, have been enormous. We are now able both to bring the international community of pilots closer to each other, and by Internet publishing to put the catalogue within reach of a far greater number of pilots worldwide.

Alan Cassidy
Chairman, Catalogue Sub-Committee

Maidenhead, England
December 1998

CONTENTS

ACKNOWLEDGEMENTS

The Federation Aeronautique Internationale (FAI) Aerobatic Catalogue, adopted in 1987, has been produced at the request of the FAI Aerobatics Commission (Commission Internationale de Voltige Aerienne).

A derivative of various work done by aerobatic enthusiasts from around the world, particular tribute is paid to the valuable suggestions and improvements proposed by Sr. José L. Aresti of Spain and Mr. Eric Müller of Switzerland.

The FAI Aerobatic Commission's sub-committee on the catalogue, which first compiled this version over a period of two years, had the following members:

Peter Celliers	Chairman	South Africa
Patrick Paris	Member	France
Louis Cabre	Member	Spain
Hans Bauer	Member	Germany
Helmut Stas	Member	Poland
Clint McHenry	Member	USA
Kasum Nazhmudinov	Member	USSR
Annette Carson	Secretary	England

FAI AEROBATIC CATALOGUE

RECORD OF AMENDMENTS

Date	Amdt. No.	Revision details	Changed Pages
1987-1997	1-4	Revisions of original 1987 version	
January 1999	2nd Edition	Completely revised edition with deletion of Family 4, addition and modification of figures in Families 1, 8 and 9.	

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I - DESCRIPTION OF THE CATALOGUE

THE FAMILIES

1. The FAI Aerobatic Catalogue consists of the following Families of figures:

   1.1. Family 1 – Lines and Angles

   1.2. Family 2 – Turns and Rolling Turns

   1.3. Family 3 – Combinations of Lines

   1.4. Family 4 – Not in Use

   1.5. Family 5 – Stall Turns (Hammerheads)

   1.6. Family 6 – Tailslides

   1.7. Family 7 – Loops & Eights

   1.8. Family 8 – Combinations of Lines, Angles and Loops

   1.9. Family 9 – Rolls and Spins

BASIC FIGURES AND COMPLEMENTARY ELEMENTS

2. Families 1 through 8 contain diagrams showing the aircraft's flightpath, each diagram being designated a 'Basic Figure'. Many such basic figures (e.g. 7.5.1, the Loop) can be flown, without modification, and be considered complete aerobatic figures. Others (e.g. 7.6.1, the Loop with a half-roll) cannot be flown without the addition of a complementary element.

7.5.1 Loop 7.6.1 Loop with half-roll

Figure 1

3. In basic figures, flight with a positive or zero angle of attack is shown with a solid line; flight with a negative angle of attack is shown with a dashed line. In this description, simple dotted lines are used when no specific angle of attack is shown. Flight lines may be vertical, horizontal or at 45° to the horizontal. No other angles are permitted. Each figure starts and ends in horizontal flight, depicted respectively by a small circle

and a short cross-line. The cross-line is vertical for figures ending on the main axis and horizontal for those ending on the secondary axis.

4. Family 9 contains symbols representing aircraft rotations of various sorts. These are designated 'Complementary Elements' and cannot be considered to be figures in isolation. A complementary element from Family 9 must always be superimposed on a basic figure from Families 1, 5, 6, 7 or 8. Then it may form a complete aerobatic figure.

5. Family 9 elements can be any one of the following: aileron roll without or with hesitations (a) & (b), rudder roll (flick or snap roll) (c) & (d) or spin (e) & (f). Flick Rolls and Spins may be Positive (c) & (e), or Negative (d) & (f). Symbols are conventionally used to differentiate these various types of rotation as follows:

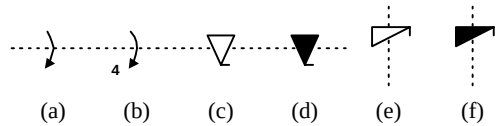

Figure 2a

6. When depicting aileron rolls, the arrows are drawn so as to be concave in the direction of flight. Flick rolls are depicted by an isosceles triangle, spins by a right-angled triangle. In flick rolls, the short tail at the apex of the symbol indicates the direction of flight. Spins always occur on vertical down lines entered from horizontal flight.

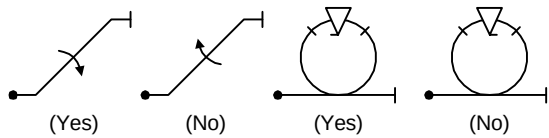

Figure 2b

REPRESENTATION OF COMPLEMENTARY ELEMENTS

7. In Families 1 to 8, complementary elements are conventionally shown by the inclusion of one of four possible symbols:

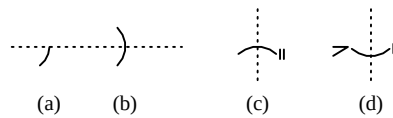

Figure 3

7.1. **The Compulsory Half-Roll Symbol (Fig 3a).** Where this occurs, on either a horizontal or 45° line, the aircraft must roll such as to finish 180° displaced from its original attitude for the figure geometry to be correct. This rotation may be accomplished by a simple 180° roll or by a combination producing the same net effect (Fig 4).

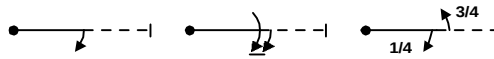

Figure 4

7.2. **The Optional Roll Symbol (Fig 3b).** Where this occurs, on either a horizontal or 45° line, the aircraft may roll a complete multiple of 360° e.g. single or double rolls (Fig 5).

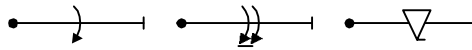

Figure 5

7.3. **The Vertical Optional Roll Symbol (Fig 3c).** Where an optional roll occurs on a vertical up or down line, the rotational element may result in a net change of attitude of a multiple of 90°. This can be achieved by a single complementary element or by a combination of such elements.

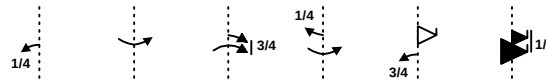

Figure 6

7.4. **The Optional Spin Symbol (Fig 3d).** Where a basic figure from Families 1 or 8 starts with a vertical down line, the first rotation of a complementary element may be by spinning from level flight rather than by pulling (or pushing) to the vertical down and rolling.

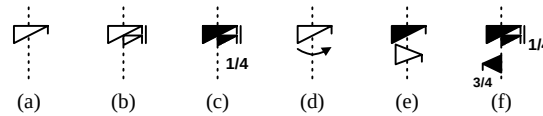

Figure 7

EXTENT OF ROTATIONS

8. Continuous rotation is in multiples of 90° but may not be greater than 720°.

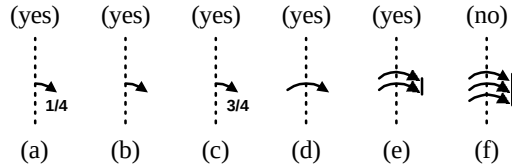

Figure 8

COLOUR CONVENTIONS

9. When drawings are printed in colour, negative lines, negative flick (snap) rolls and negative spins may be shown in red. Corresponding positive elements are invariably shown in black.

'CORNER' CONVENTIONS

10. All basic figures except Family 1.1 depict a flightpath that has looping portions. When such a looping element has at least 180° of pitch, it is depicted in the diagrams as a curve. When it is less than 180°, the element is shown as a 'corner'. Despite being drawn for convenience in this manner, all such corners are to be interpreted as being flown in a continuous curve of constant and significant radius.

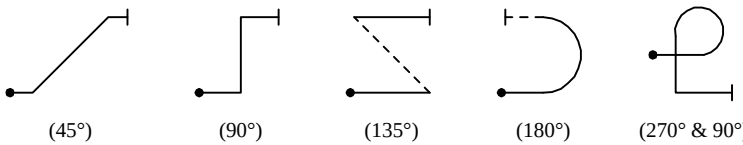

Figure 9

CATALOGUE NUMBERS AND DIFFICULTY COEFFICIENTS

11. All the basic figures in Families 1 to 8 are defined in accordance with a 3-number system. The first number indicates the Family to which the figure belongs. The second figure shows the row, and the third the column, in which the figure is placed. The numbers are separated by dots.

12. As a general rule, figures in columns 1 and 2 ascend, those in column 1 starting in upright flight, column 2 inverted. Figures in columns 3 and 4 descend, column 3 starting in upright flight, column 4 inverted.

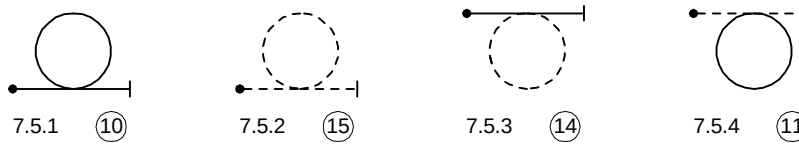

Figure 10

13. Each of the complementary rotation elements from family 9 is defined in accordance with a 4-number system. The first number is always a 9. The second number corresponds to the type of rotation, the third (row) to the direction of the underlying flightpath and the fourth (column) to the extent of rotation in multiples of 90°.

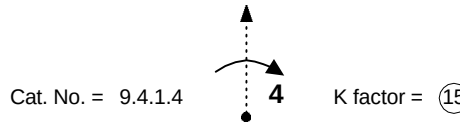

Figure 11

14. Difficulty coefficients (K factors) for basic figures are shown in circles beside the symbols. Those for Family 9 are shown in tabular form.

15. When a basic figure and one or more complementary elements are combined to form a complex figure, the total K-factor for the figure is the sum of the difficulty coefficients for the individual parts.

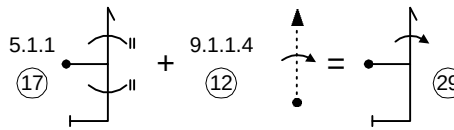

Figure 12

MULTIPLE, OPPOSITE AND UNLINKED ROTATIONS

16. Multiple continuous rotations are shown by the tips of the symbols being linked by a small line.

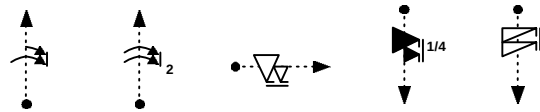

Figure 13

17. Figure 3 showed the various symbols used to show where rotation elements may be included. Paragraph 7 illustrated how these should be shown on drawings. Wherever a rotation sign appears,

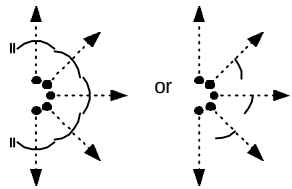

Figure 14

the rotational element may consist of a single item,

Figure 15

or a combination of two (not more) items.

Figure 16

18. By definition, there are three types of rotation (see also paragraph 5):
    18.1. Aileron Rolls (continuous or hesitation),
    18.2. Flick Rolls (positive or negative) and
    18.3. Spins (positive or negative)
19. Where two rotational elements of the same type are combined, the rotations must be in opposite roll directions, as shown by the position of the tip of the symbol.

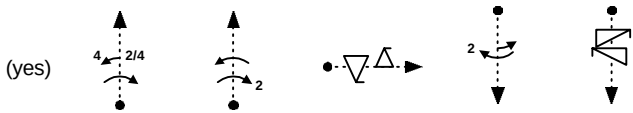

Figure 17

If the rotational elements are of differing types, they may be opposite,

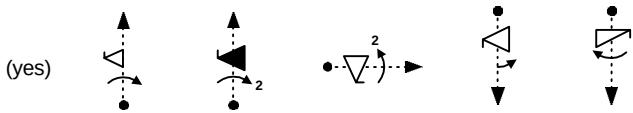

Figure 18

or in the same direction but unlinked.

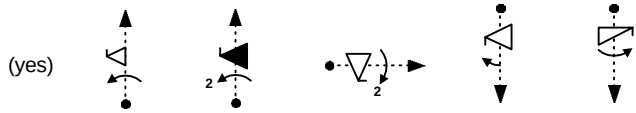

Figure 19

20. Unlinked rolls of the same type and the same direction are not allowed.

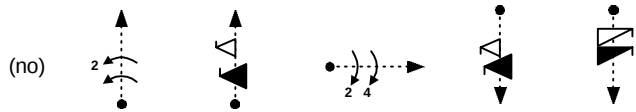

Figure 20

21. When unlinked or opposite rolls are flown, there must be a brief but perceptible pause between them, as in a hesitation roll.

22. The Catalogue numbers and K-factors are all taken into account in describing and evaluating the figure.

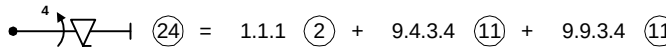

Figure 21

POSITIVE AND NEGATIVE FLICK ROLLS

23. A positive flick roll is easier to perform when placed on a line where the aircraft already has a positive angle of attack (solid line). Similarly, a negative flick roll is easier to perform when entered from a negative (dashed) line. Therefore, for each type of flick, in any particular direction of flight, there are two K-factors.

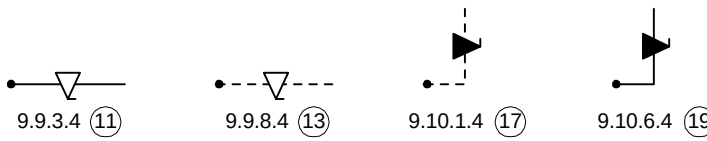

Figure 22

24. In the case of some vertical lines, however, such as after an aileron roll or spin, stall turn or tailslide, the angle of attack is deemed to be zero. In these cases, the flick roll is accorded the lower of the two possible K-factors.

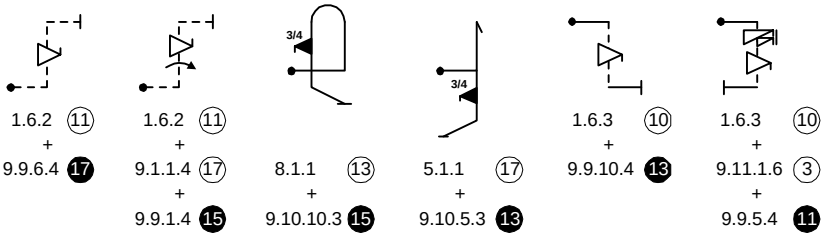

Figure 23

POSITIVE AND NEGATIVE SPINS

25. A positive (stick back) spin is easier to perform when started from an erect attitude than from an inverted attitude. Conversely for a negative (stick forward) spin. Therefore for each kind of spin there are two K-factors depending on the aircraft attitude prior to entry.

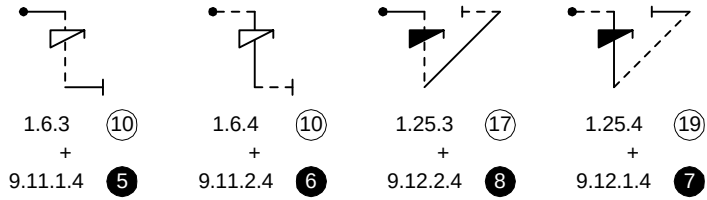

Figure 24

26. When combined with another rotation in an opposite or unlinked combination, the spin must be the first of the two elements.

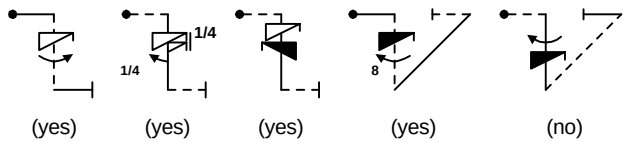

Figure 25

SAMPLE SEQUENCE CONSTRUCTION

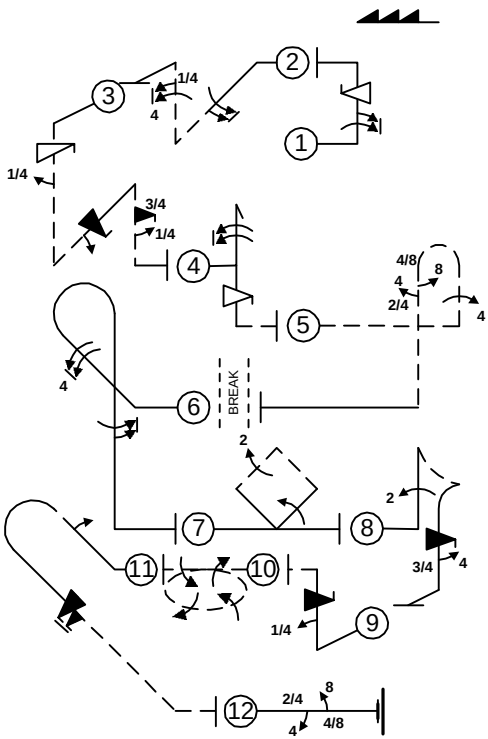

Fig 1	1.6.1 9.1.1.6 9.9.1.4	10 15 15	40
Fig 2	1.14.3 9.1.4.6 9.4.1.5	15 10 18	43
Fig 3	1.35.3 9.11.1.4 9.1.5.1 9.1.2.2 9.10.7.4 9.10.5.3 9.1.5.1	25 5 2 6 17 13 2	70
Fig 4	5.1.3 9.1.1.8 9.9.5.4	18 18 11	47
Fig 5	8.2.2 9.4.1.4 9.8.5.2 9.4.5.2	17 15 7 5	44
Fig 6	8.57.1 9.4.2.8 9.1.5.6	12 22 10	44
Fig 7	7.9.1 9.1.2.4 9.2.4.4	15 10 9	34
Fig 8	6.2.1 9.2.1.4 9.10.5.4 9.4.5.3	15 13 13 8	49
Fig 9	1.7.1 9.1.1.1 9.10.1.4	9 6 17	32
Fig 10	2.15.4	25	25
Fig 11	8.16.1 9.1.2.2 9.10.9.6	14 6 19	39
Fig 12	1.1.1 9.4.3.2 9.8.3.2	2 5 7	14
Total K = 481			

Figure 26

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II - METHOD OF EVALUATION

Note: Each basic figure and rotational element in the catalogue is accorded a difficulty coefficient or K-factor. For the basic shapes in Families 1 through 8, the manoeuvre is broken down into its different flight segments and each is given a points value. Rotational elements are given a K-factor according to their flight direction and extent. The processes are consistent and are described below.

BASE VALUES FOR DIFFERENT FLIGHT ATTITUDES

1. Straight lines:

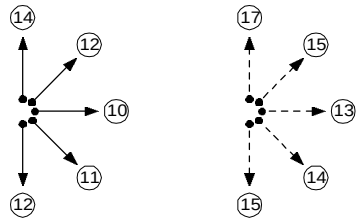

Figure 1

2. Loop arcs:

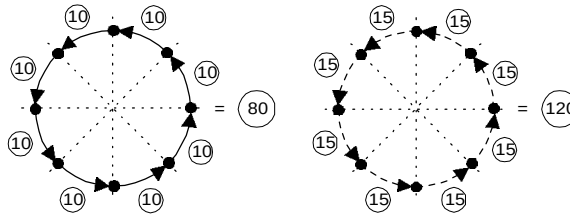

Figure 2

COEFFICIENT CALCULATIONS

LINES

3. All the positive and/or negative straight lines which have in the middle the sign of an optional 360° roll, are calculated as a single line:

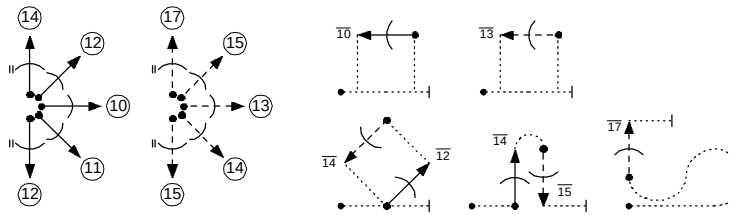

Figure 3

4. All the figures of Family 1 are excepted from this rule, as these lines have been multiplied by two.

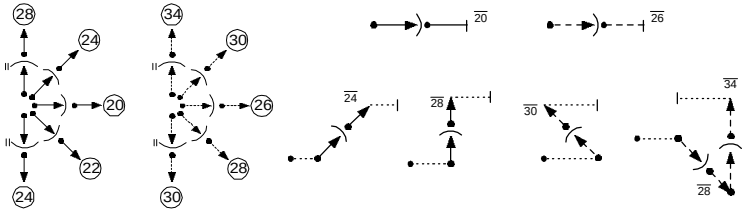

Figure 4

5. Where the attitude of the aircraft changes it is obviously two lines:

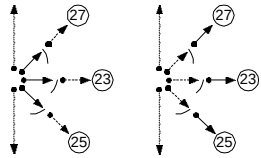

Figure 5

6. In the final calculations, all numbers are divided by 10 and rounded to the nearest whole number.

FAMILY 2

7. TURNS. A normal turn is 10 points for 90 degrees. Inverted is 13 points.

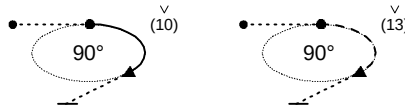

Figure 6

8. ROLLING TURNS. The basis is 200 points for 4 inside rolls in a 360° turn with 20 points more for each roll less than 4 in 360°:

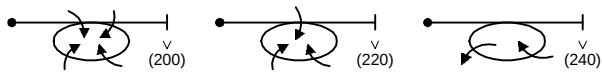

Figure 7

8.1 For inverted entry and exit it is 10 points more;
8.2 For outside rolls it is 20 points more;
8.3 For opposite rolls it is 40 points more:

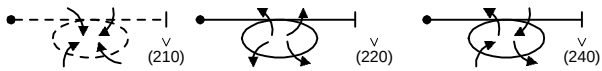

Figure 8

FAMILY 5

9. A base value of 84 points is applied to a normal entry stall turn and a value of 115 to an inverted entry stall turn:

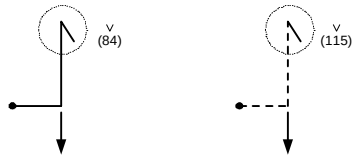

Figure 9

FAMILY 6

10. The turn around in a tailslide (either way) is 64 points:

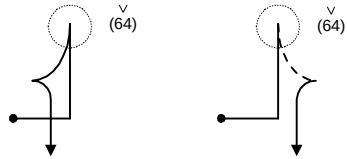

Figure 10

FAMILY 7

11. No line is counted in the vertical "S":

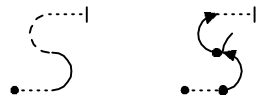

Figure 11

FAMILY 9

12. The points given for rotations are full K-factors and are not divided by 10. Two rolls linked, on any line, are given 50% more than a full roll:

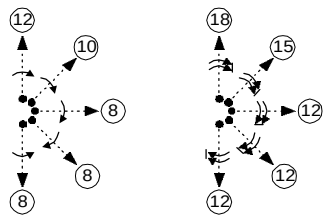

Figure 12

13. For hesitation rolls, one point is added for every stop:

Figure 13

14. For opposite rolls the full value of each roll is taken, for example:

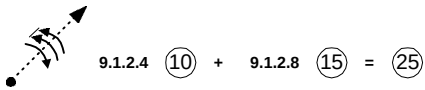

Figure 14

15. For spins, the difficulty is independent of the extent of the rotation, except for 1¼ and 1 turns, where the final flightpath is much less vertical. One point is added for each 90° less than 1½ turns.

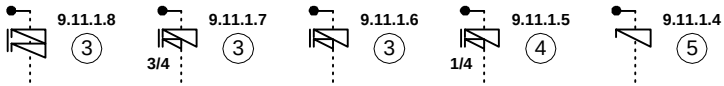

Figure 15

TOTAL COEFFICIENT OF EACH BASIC FIGURE

16. Except for Family 9, all the values are divided by 10 and then rounded to the nearest single figure:

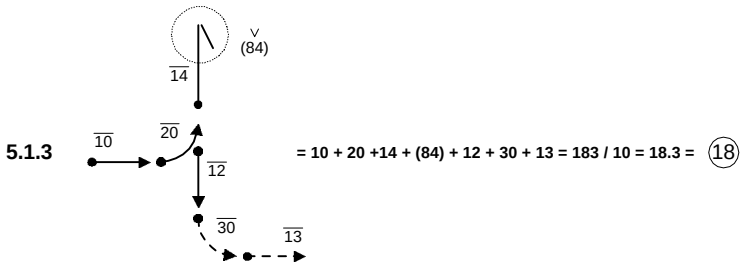

Figure 16

III – LIST OF FIGURES

CONTENTS

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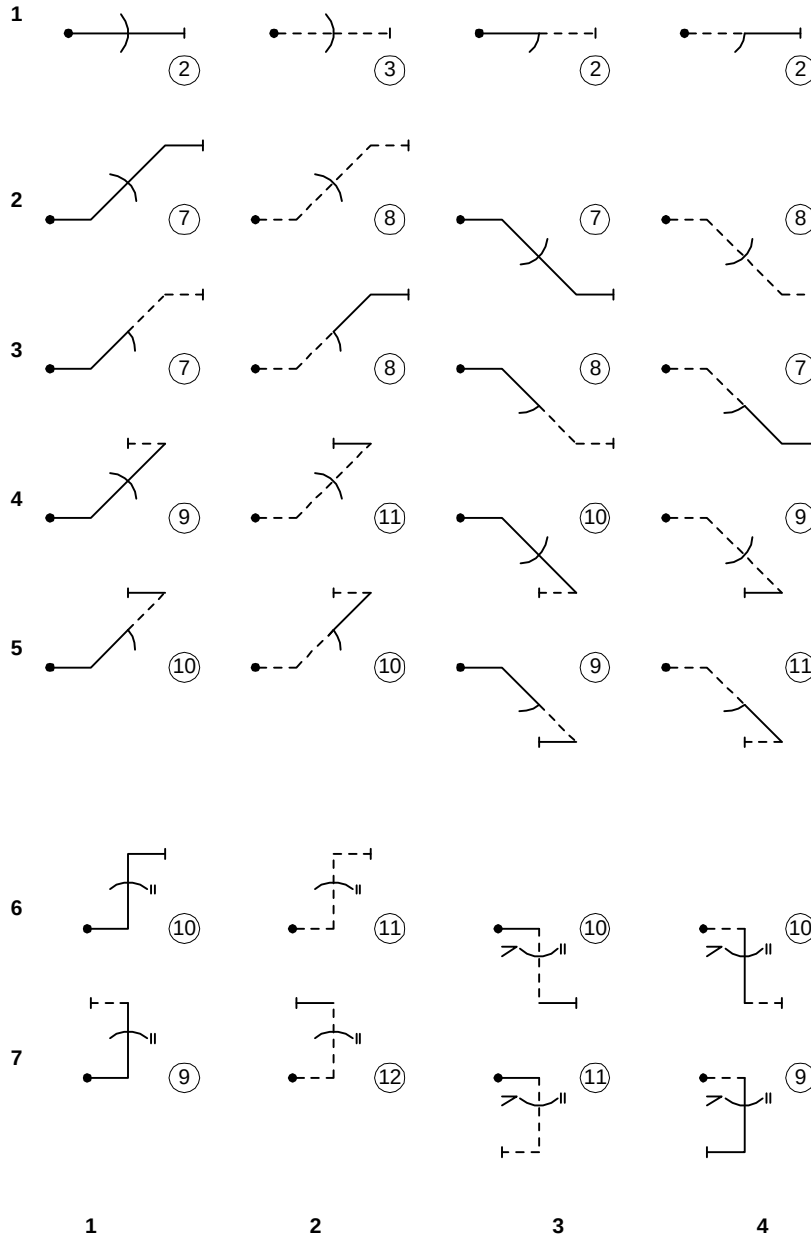
1. LINES AND ANGLES



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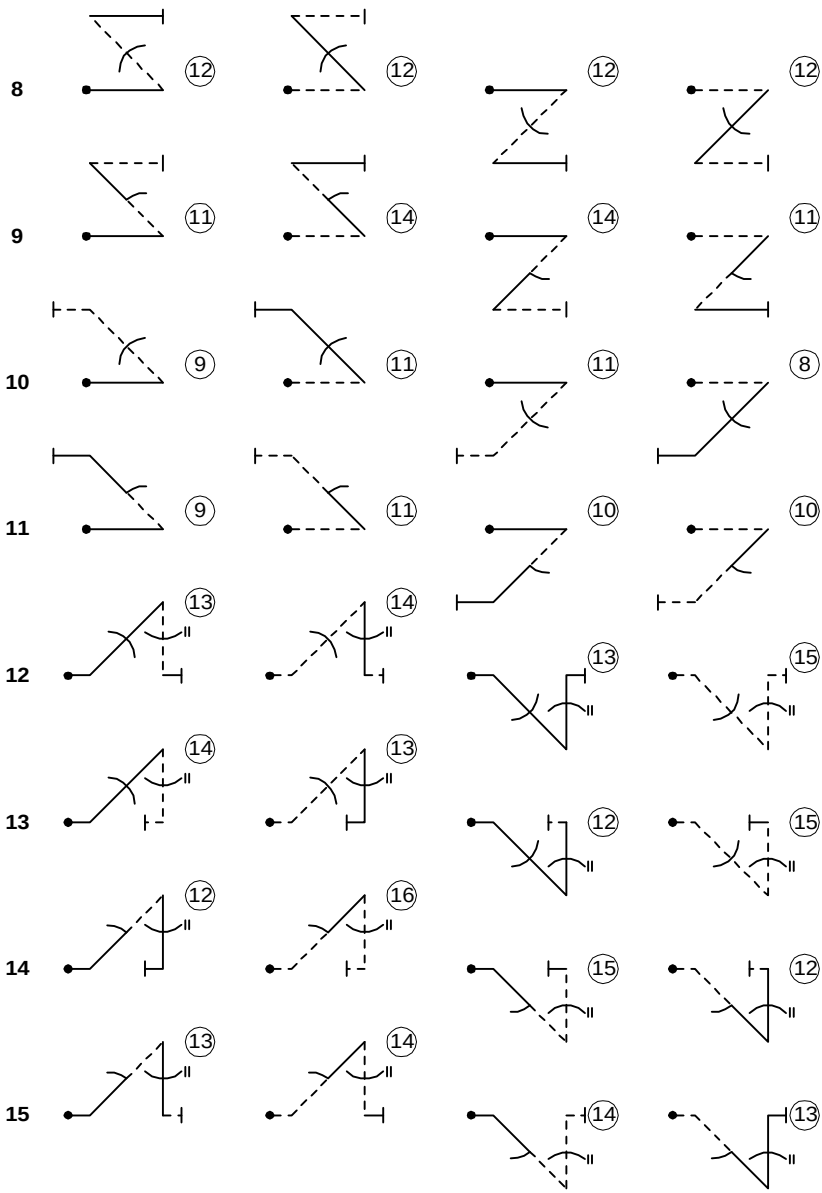

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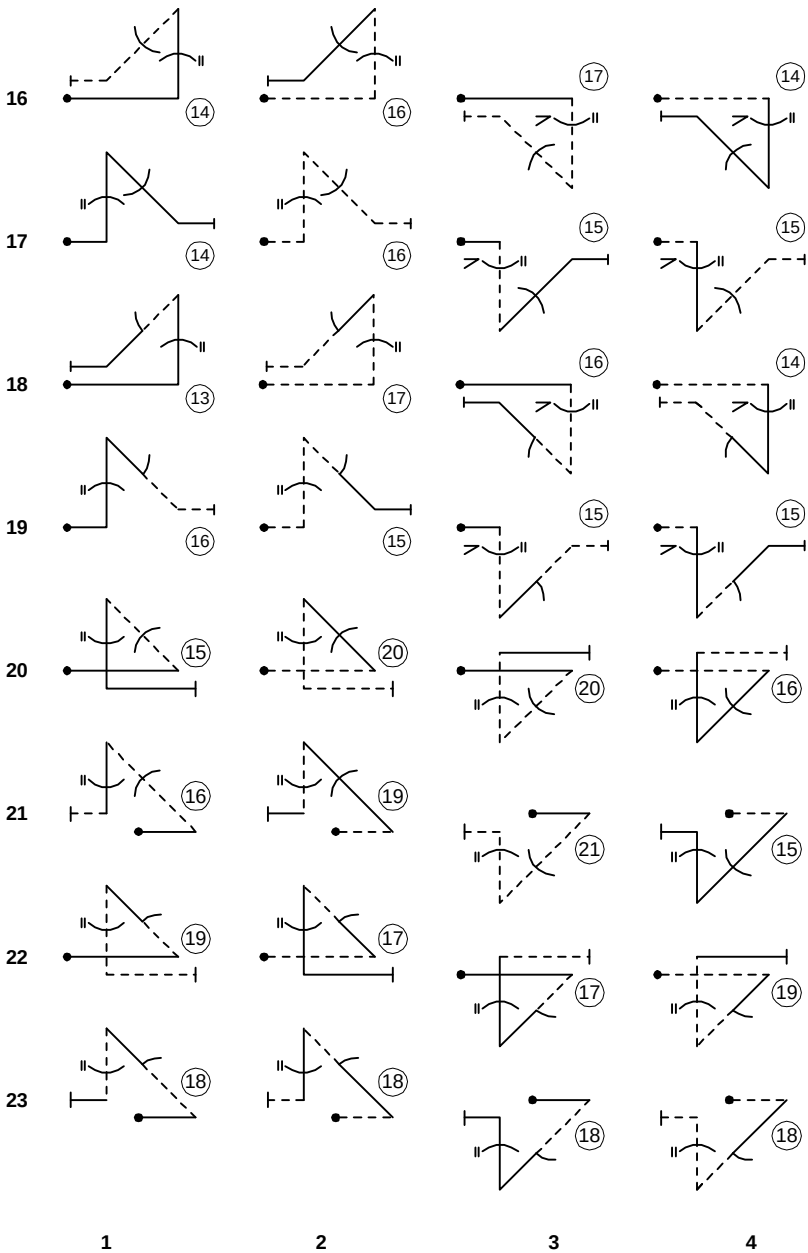

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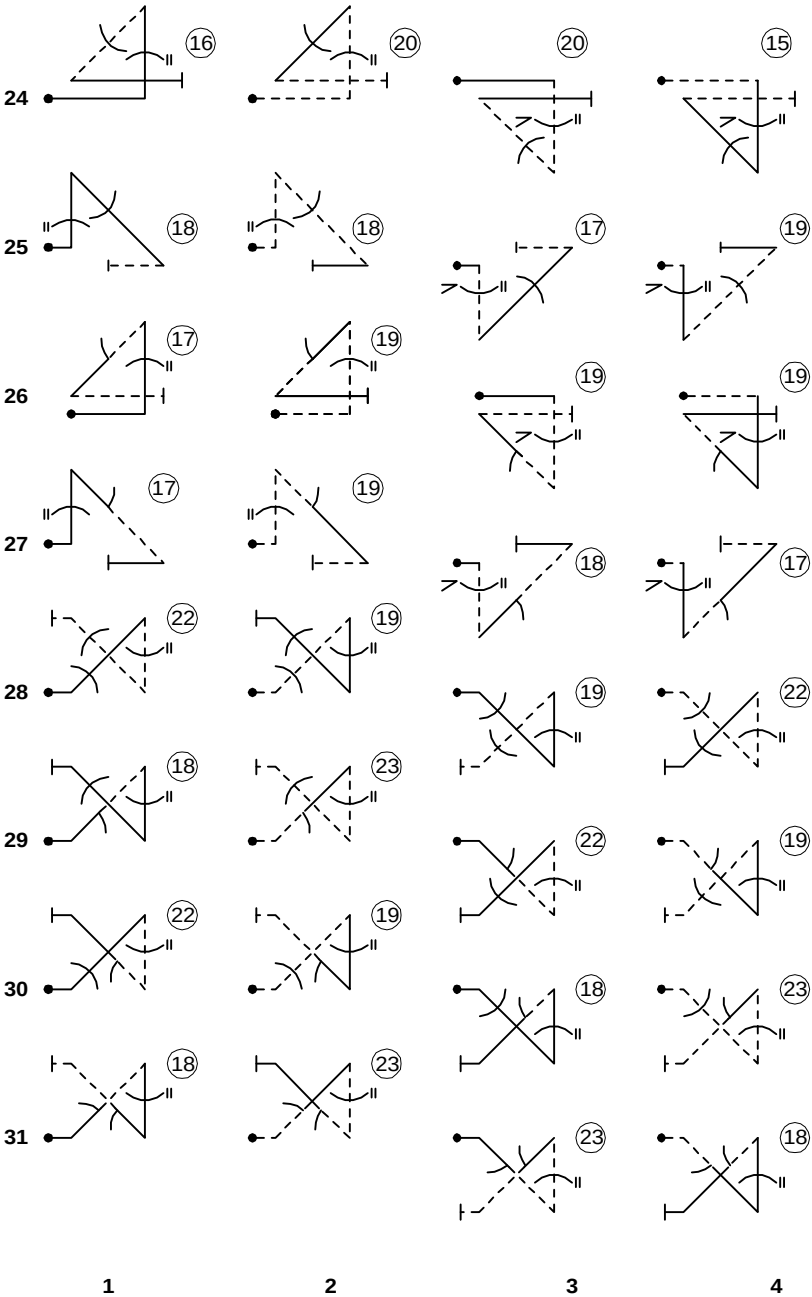
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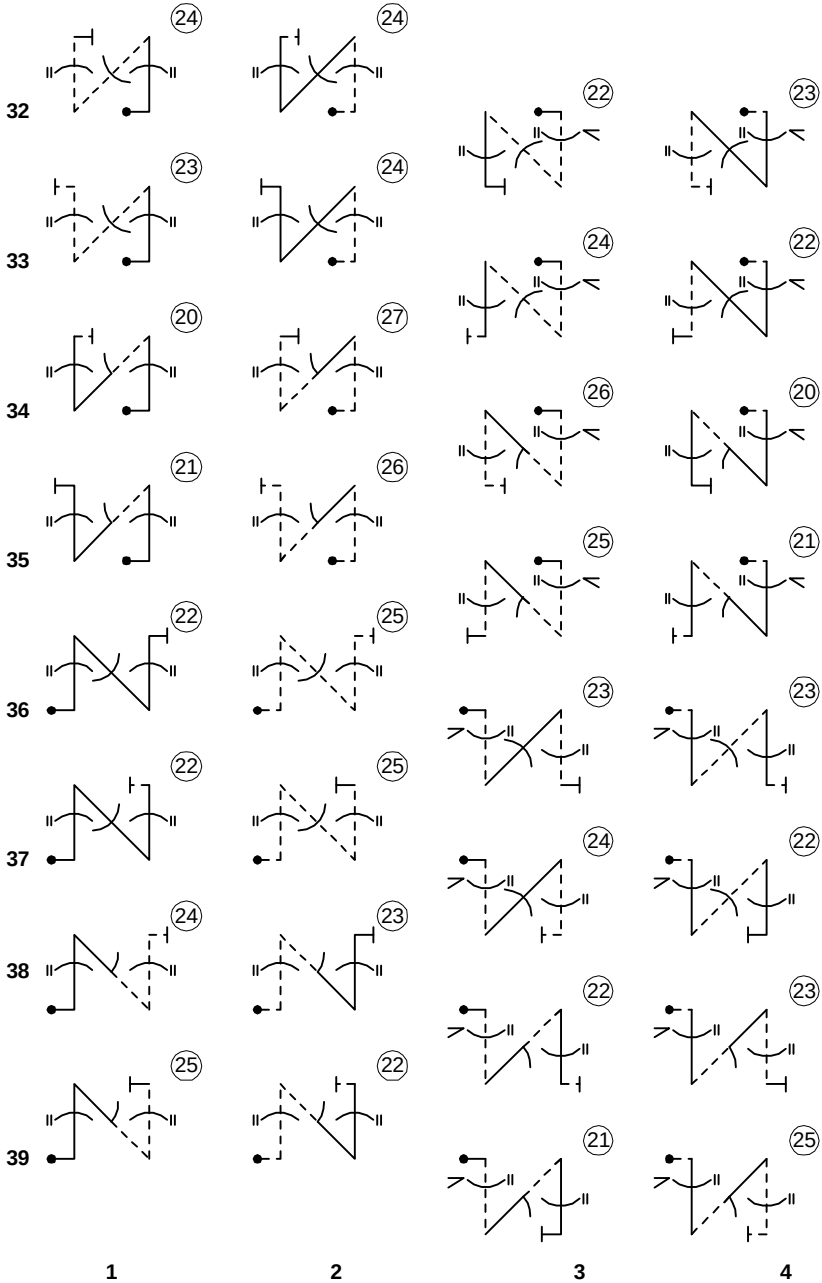
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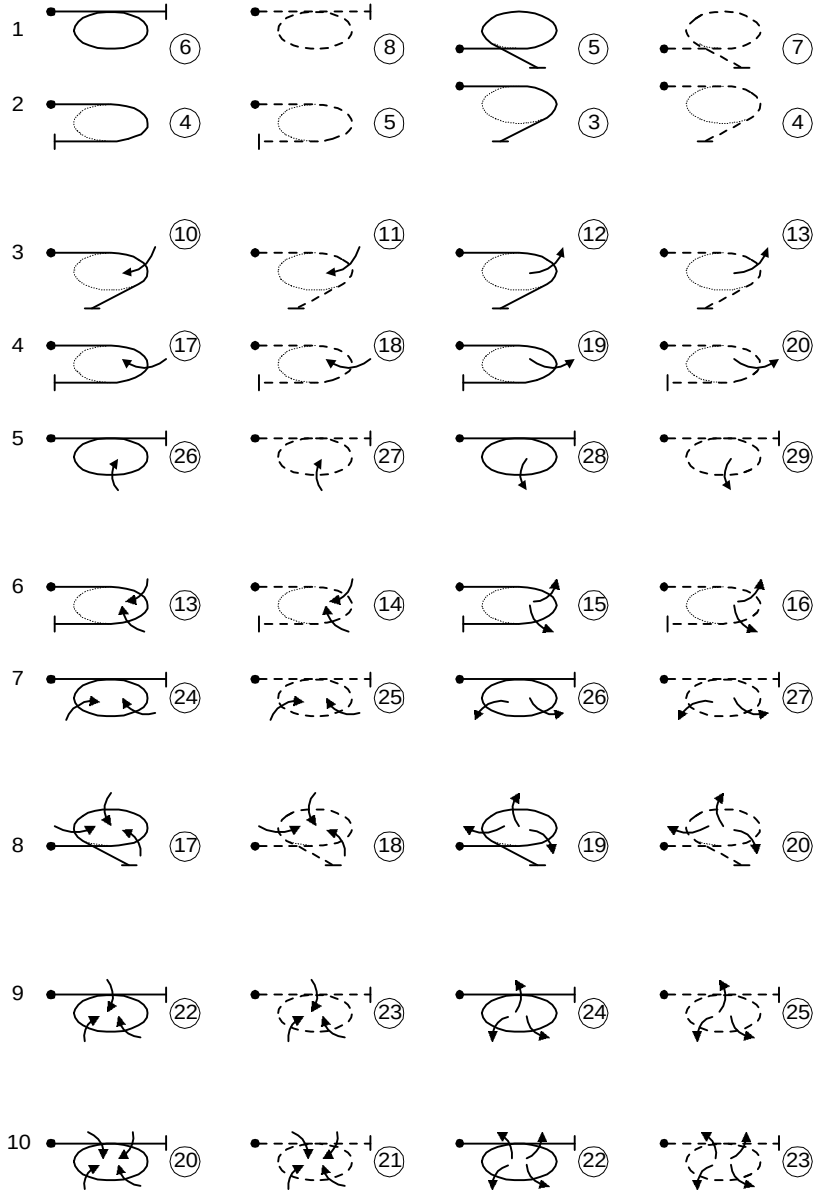
2. TURNS AND ROLLING TURNS



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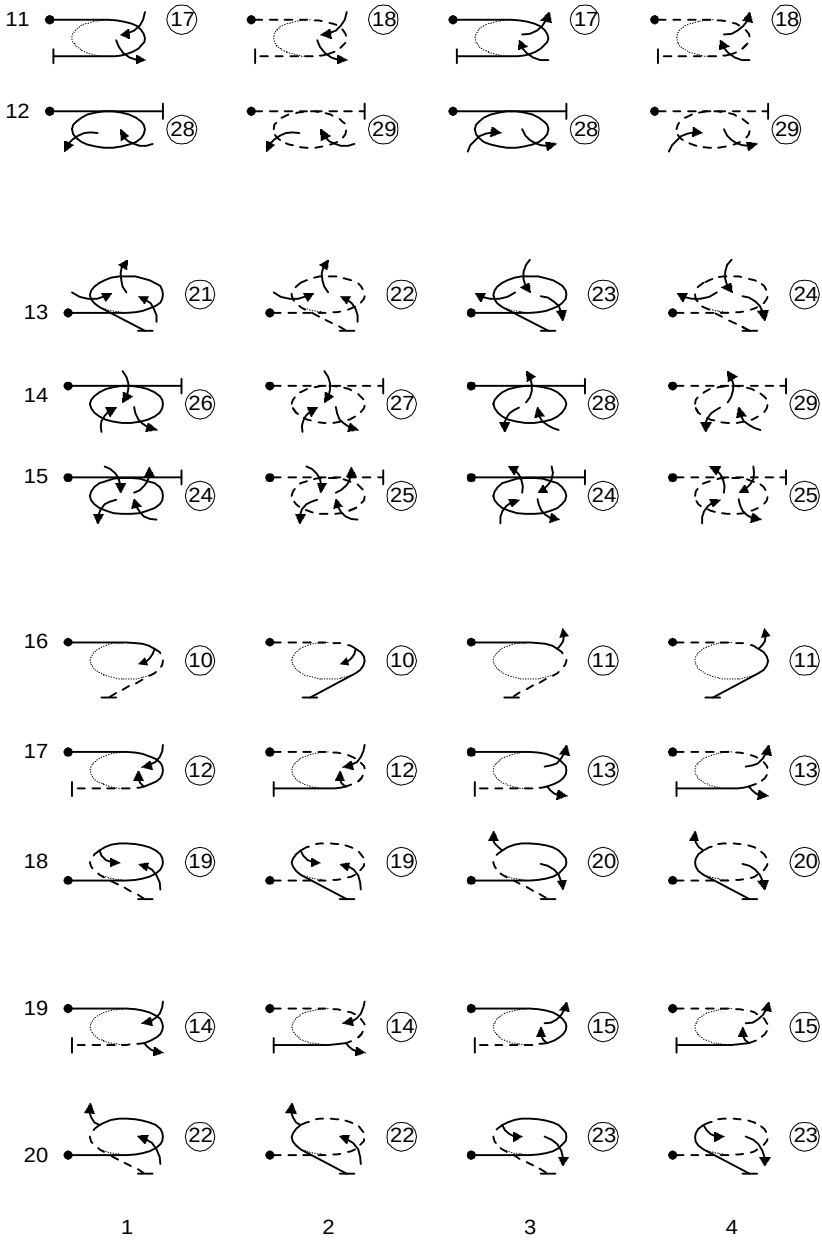
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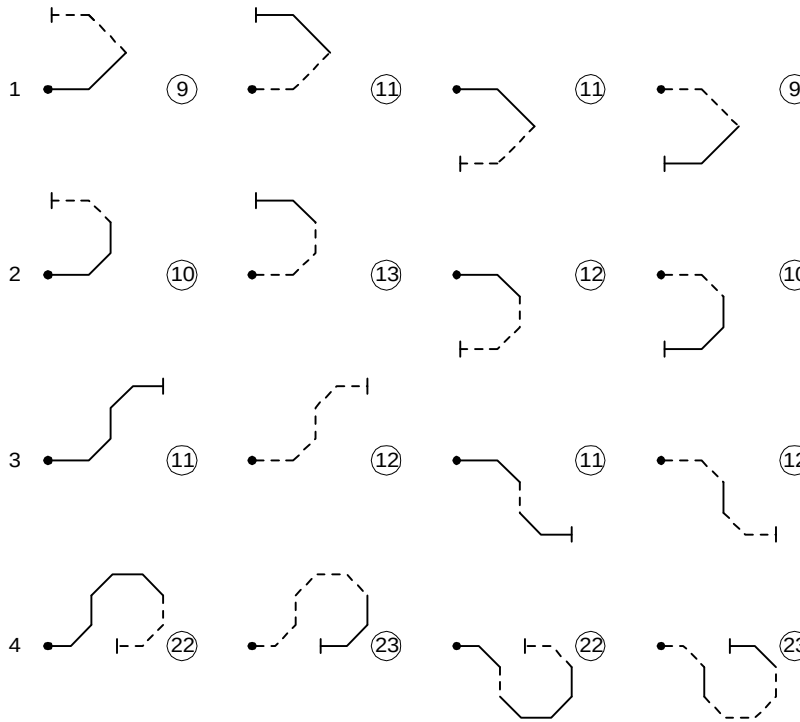
3. COMBINATIONS OF LINES



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4. NOT IN USE

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5. STALL TURNS

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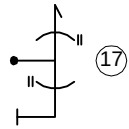

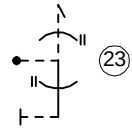

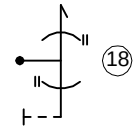

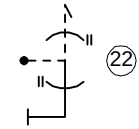

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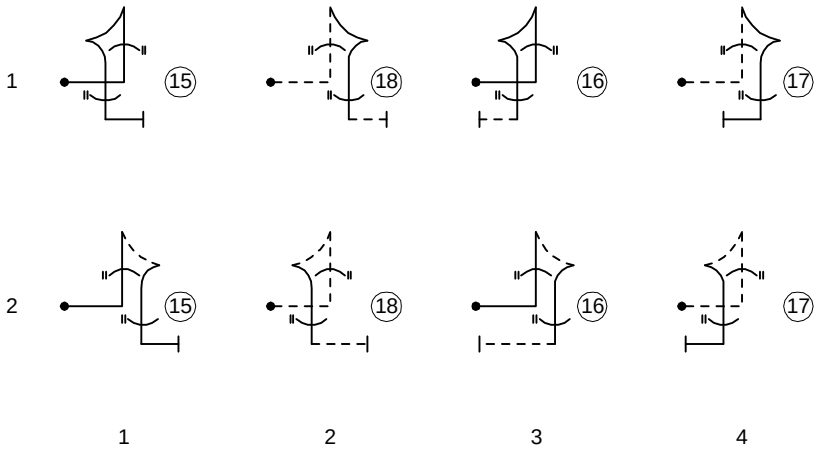
6. TAILSLIDES



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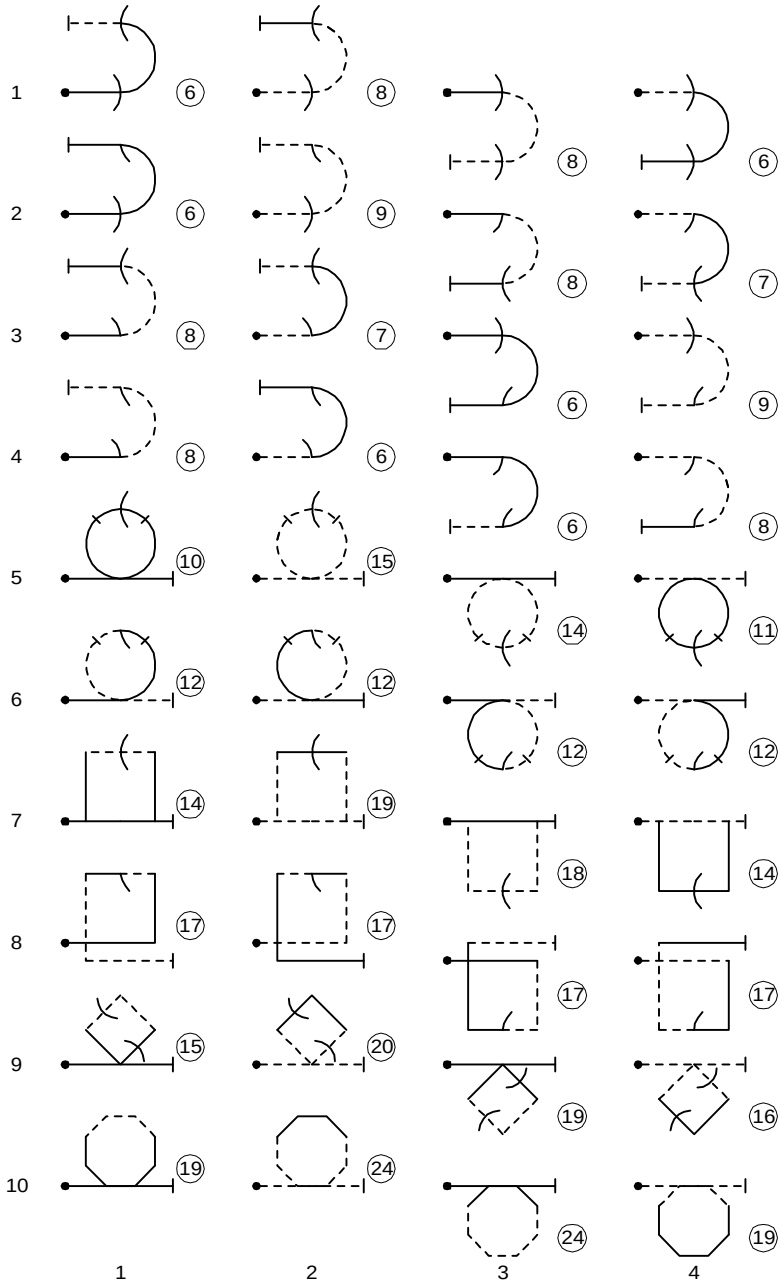
7. LOOPS AND EIGHTS



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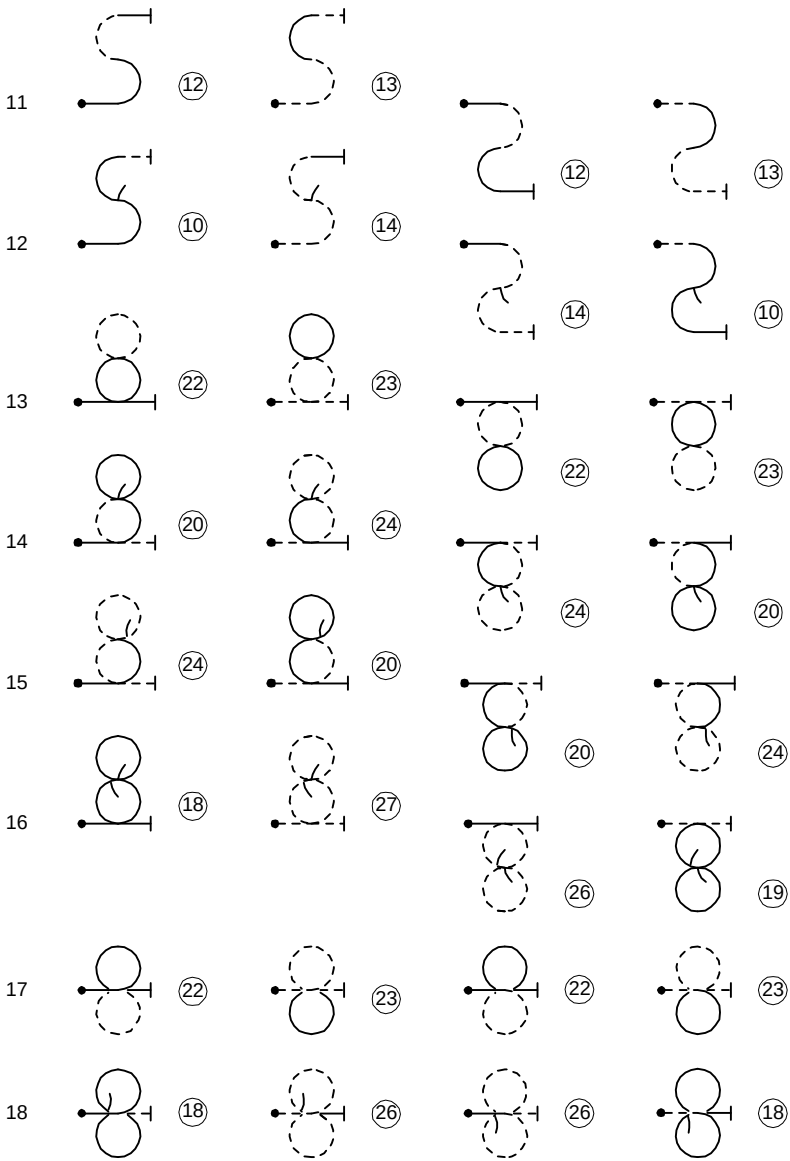

NOTE: At the sign ⌐, only half-rolls permitted.

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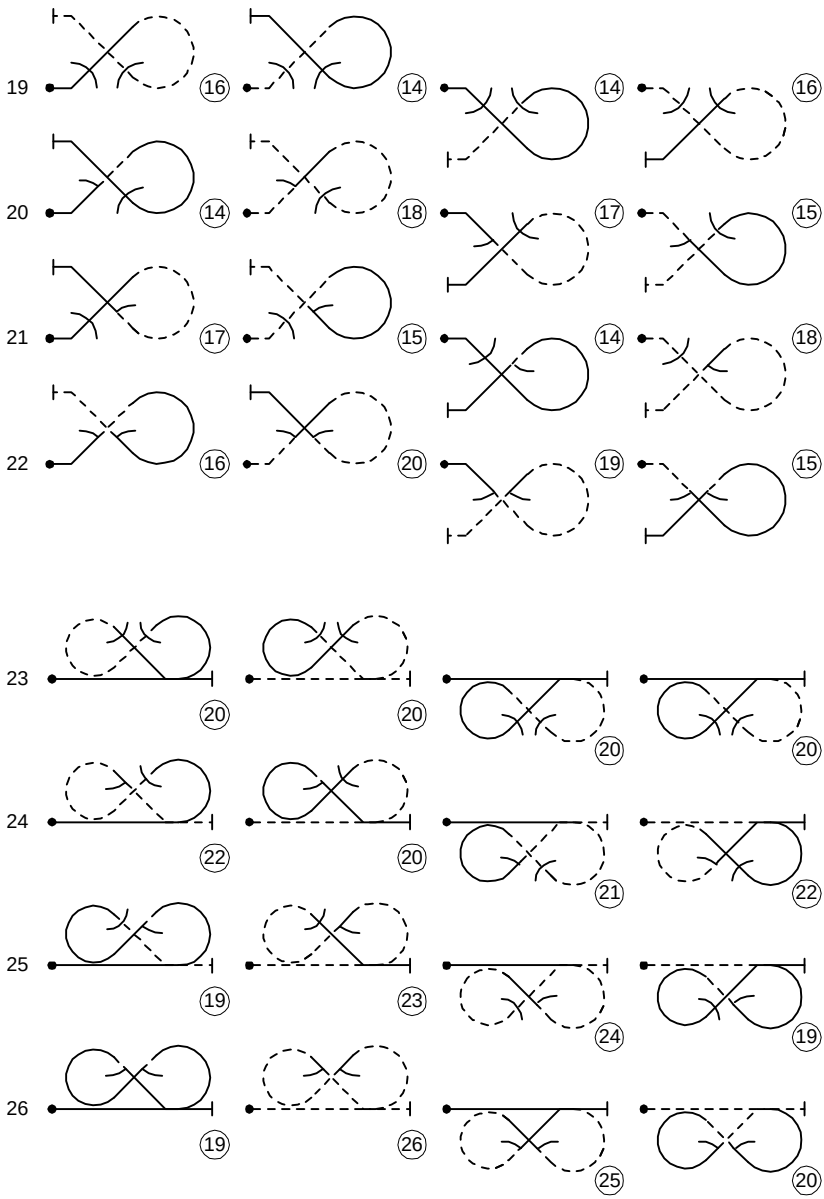
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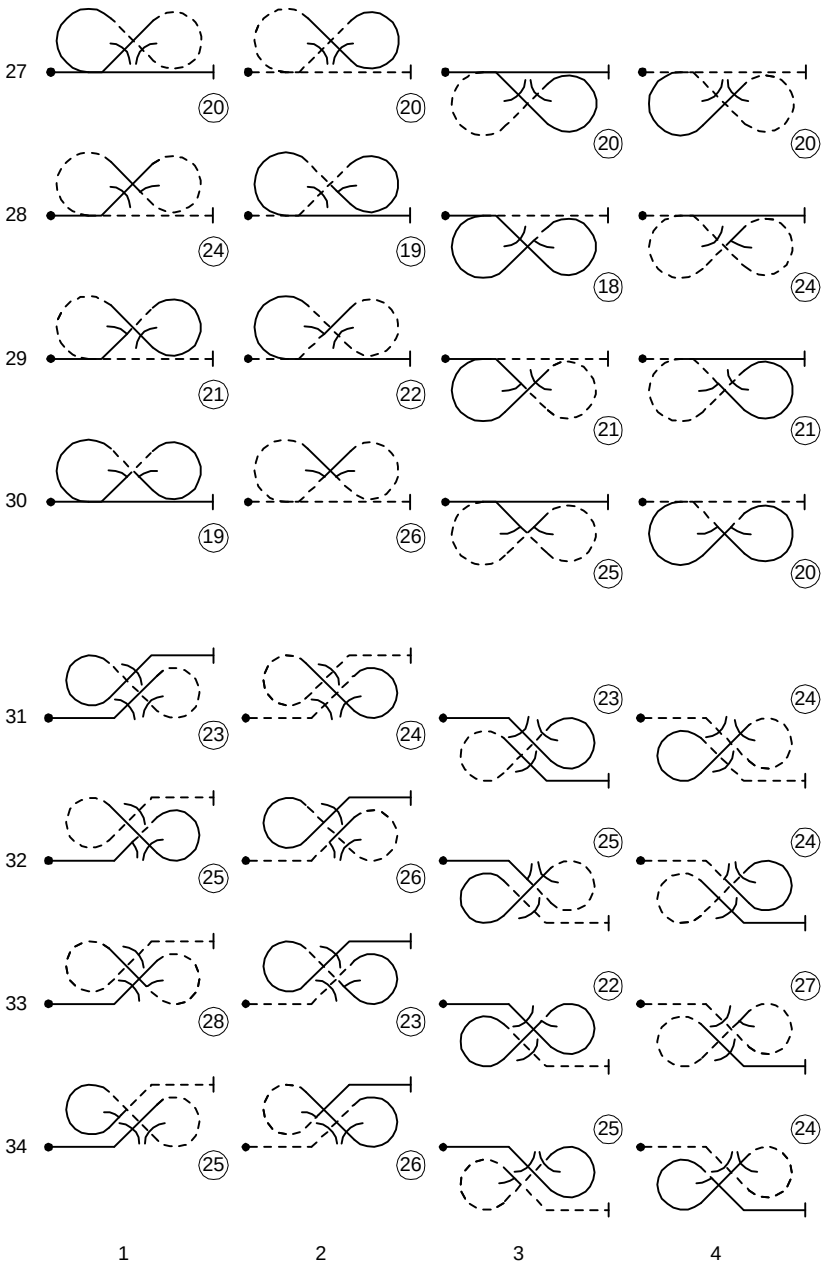
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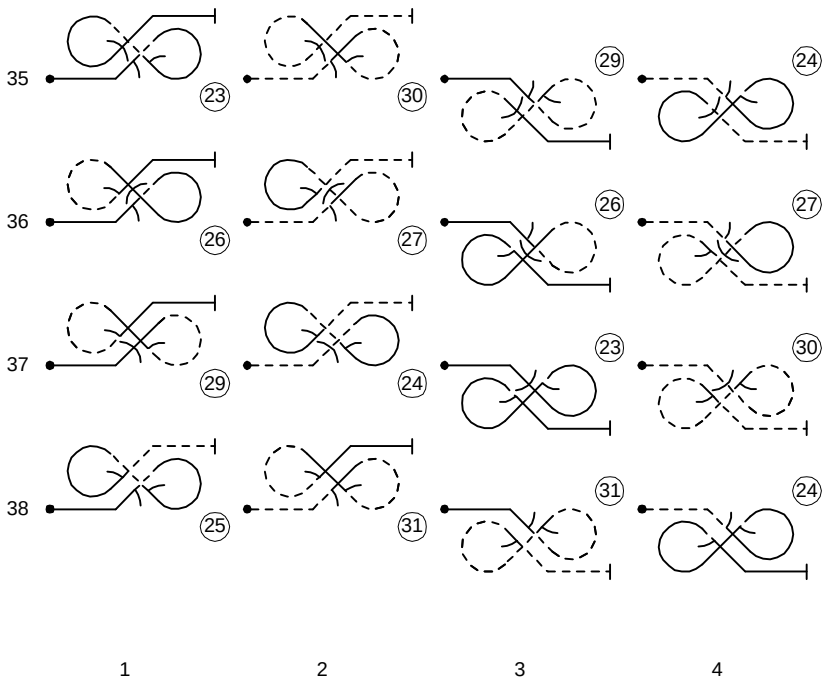

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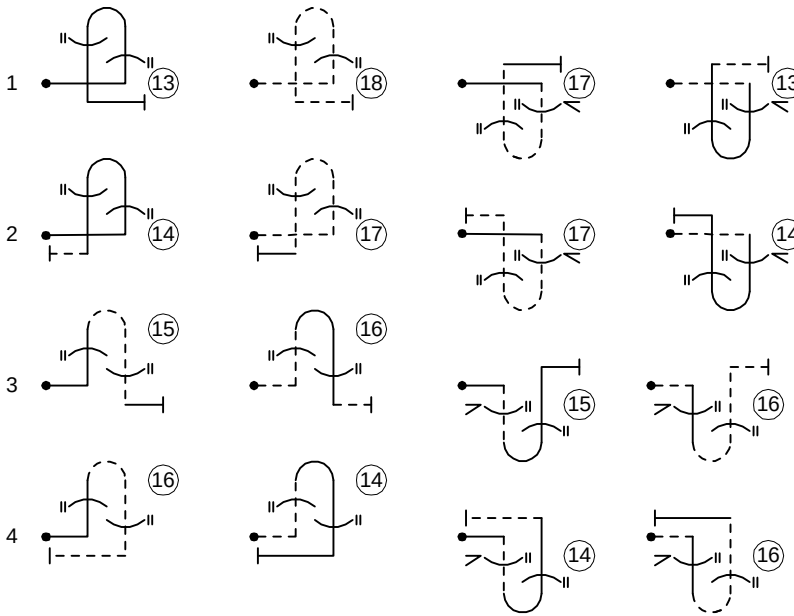
8. COMBINATIONS OF LINES, ANGLES AND LOOPS



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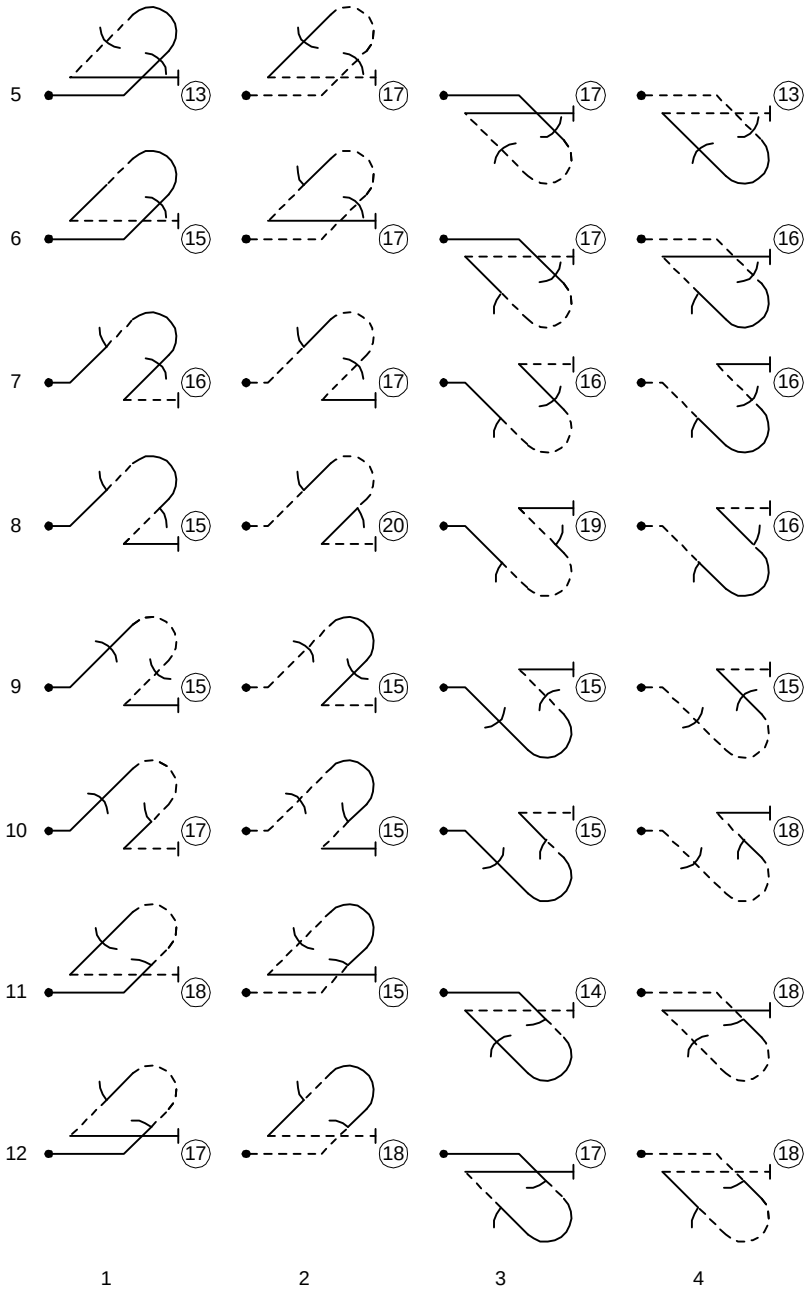
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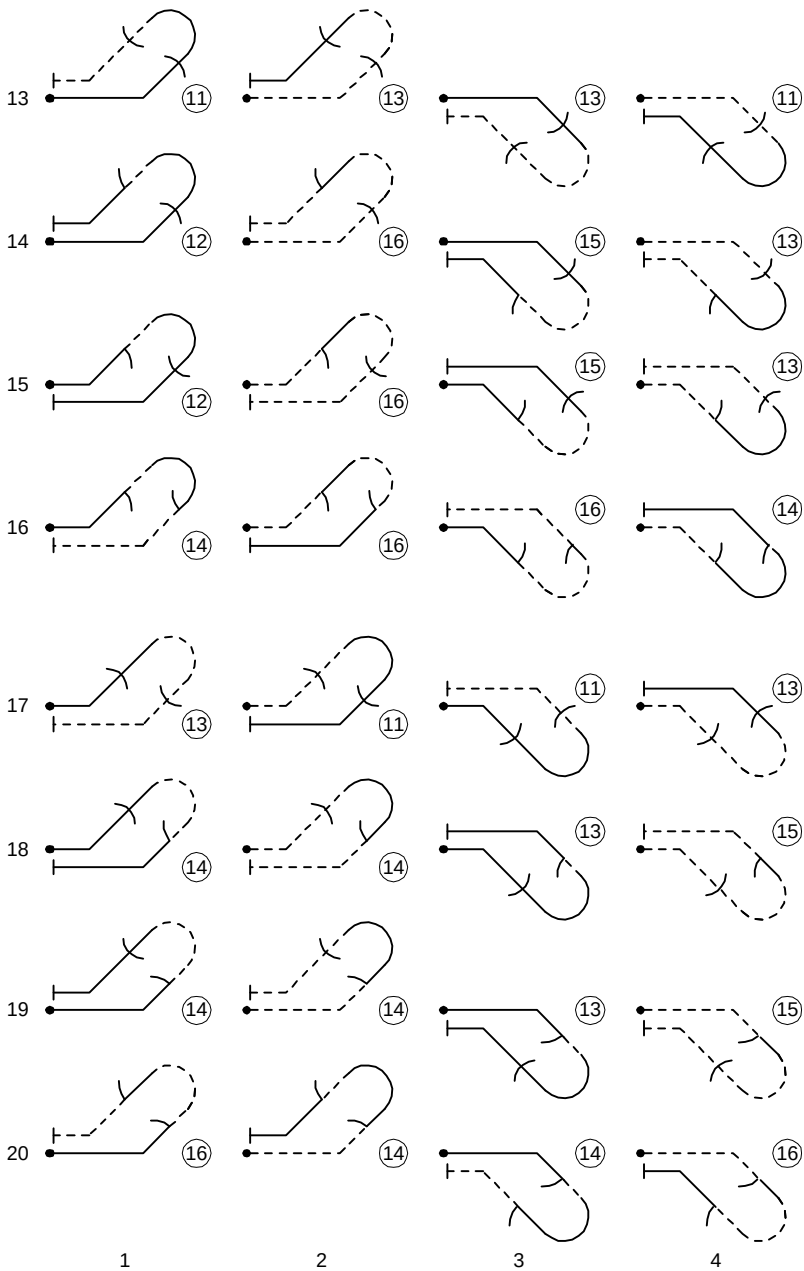
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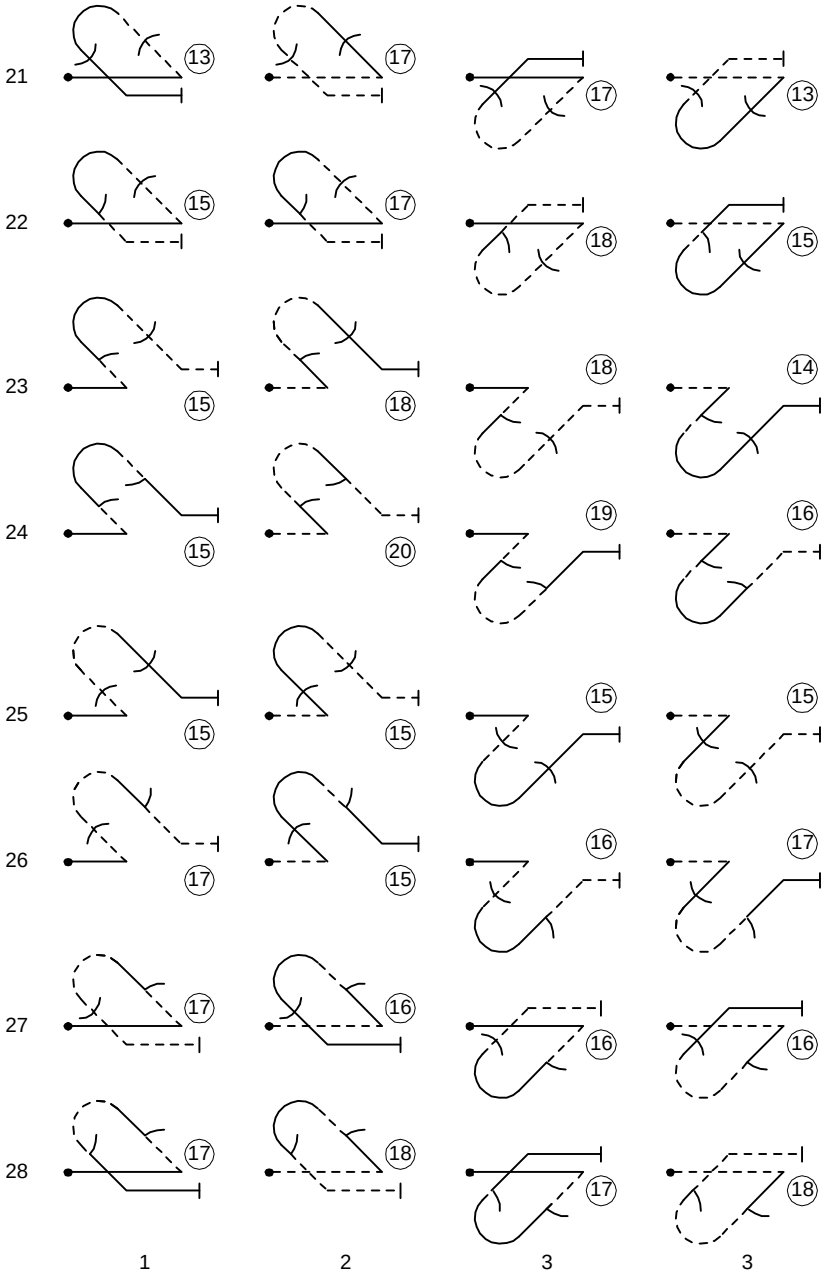
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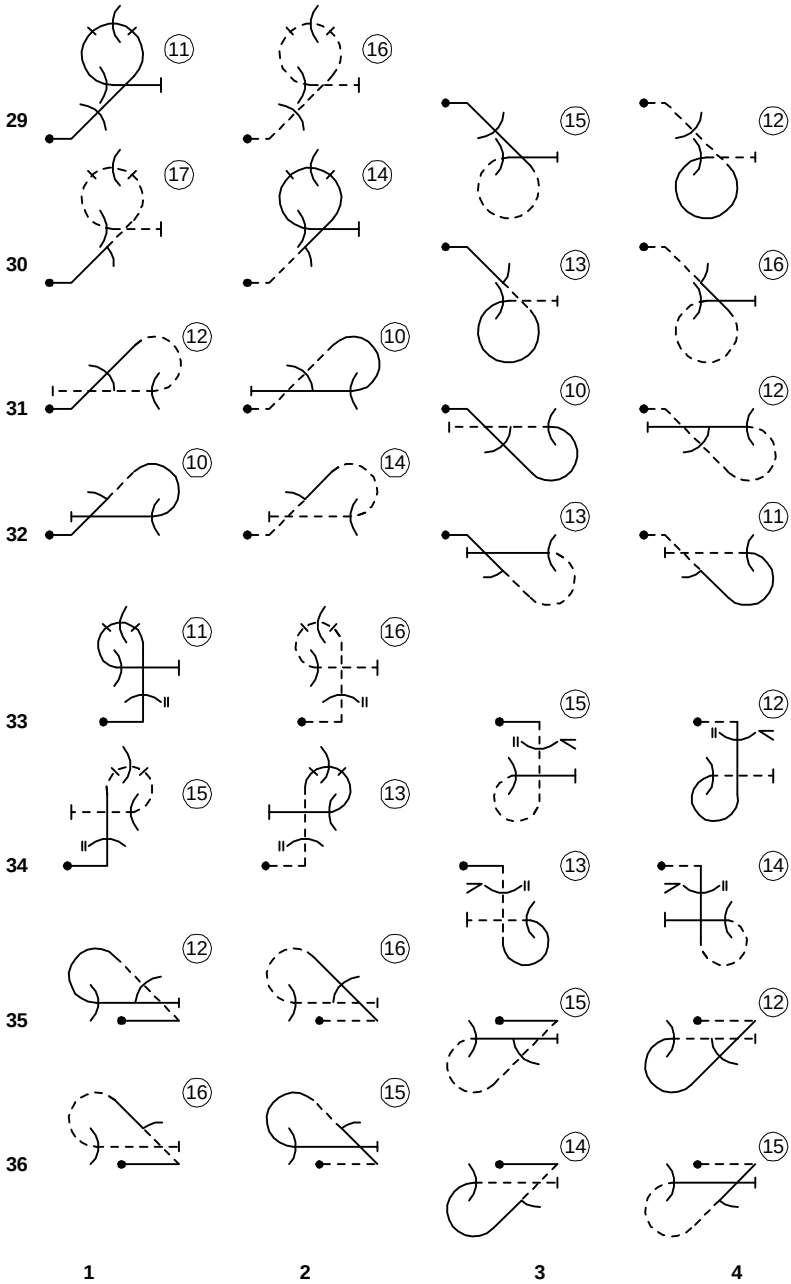

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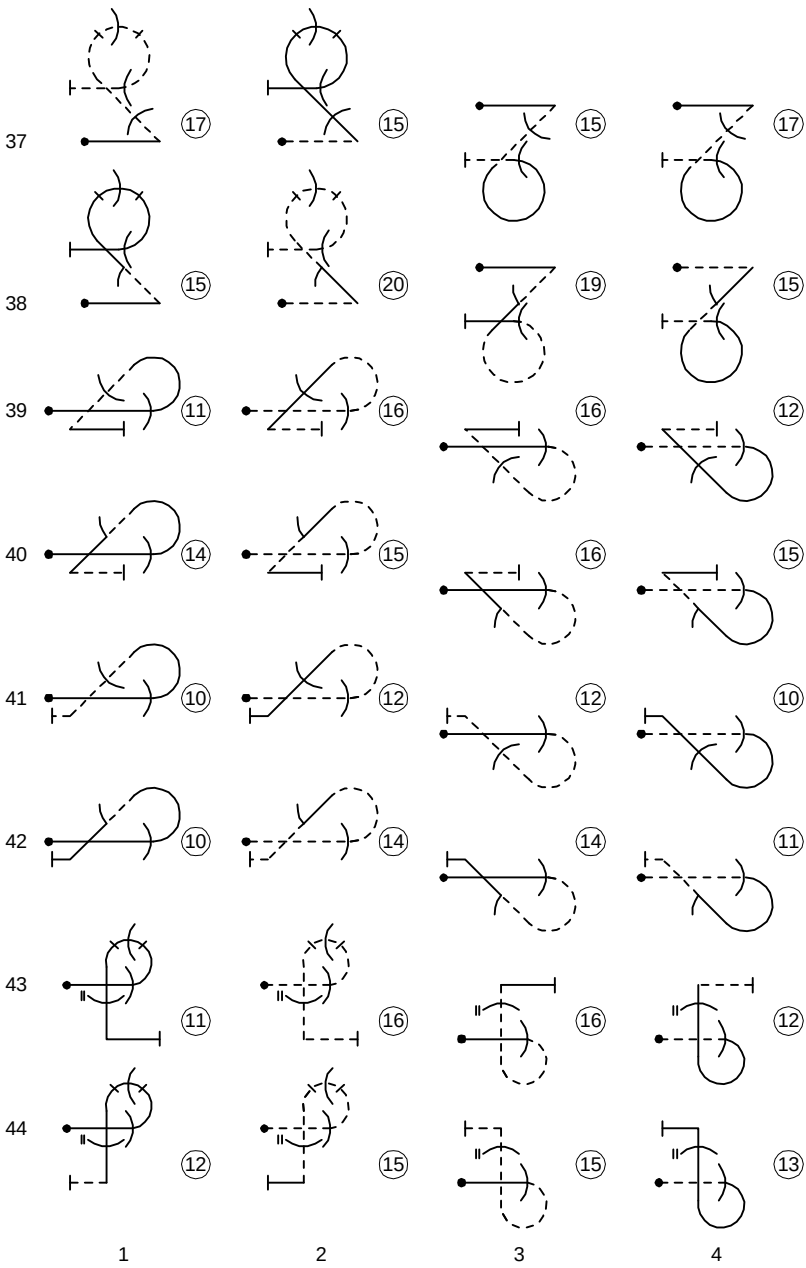
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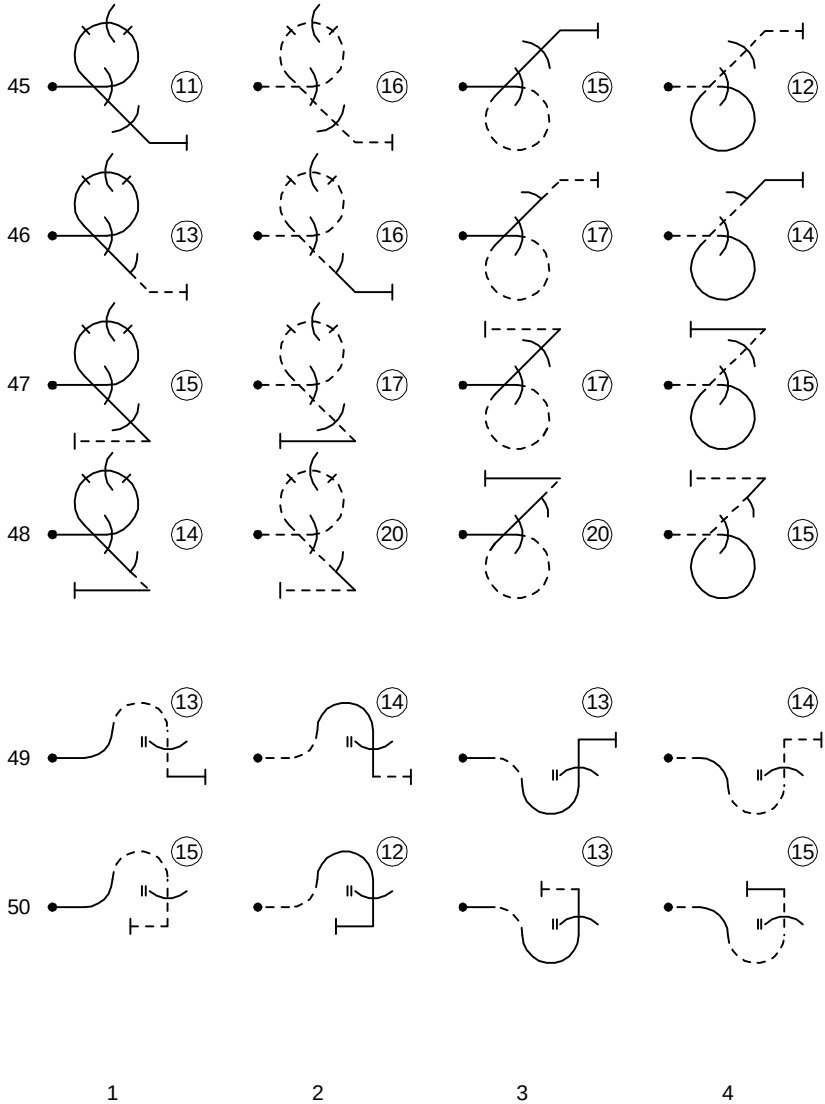
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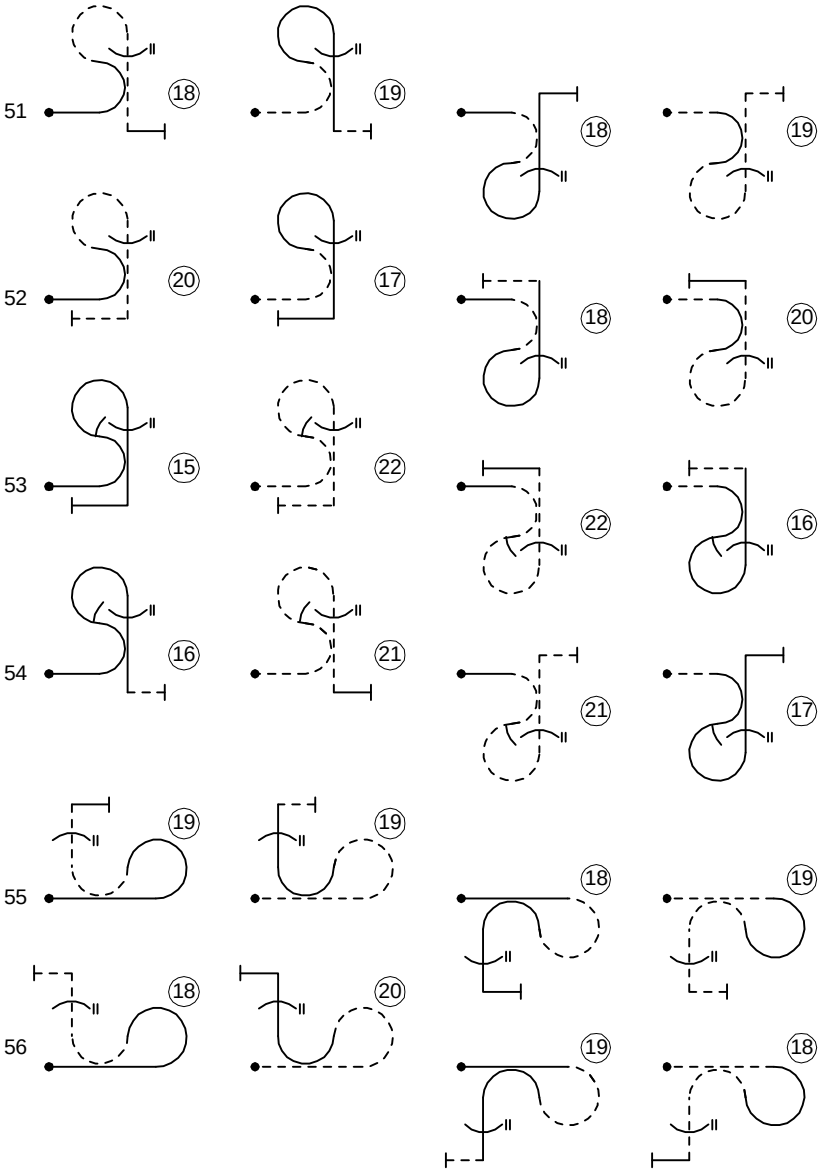
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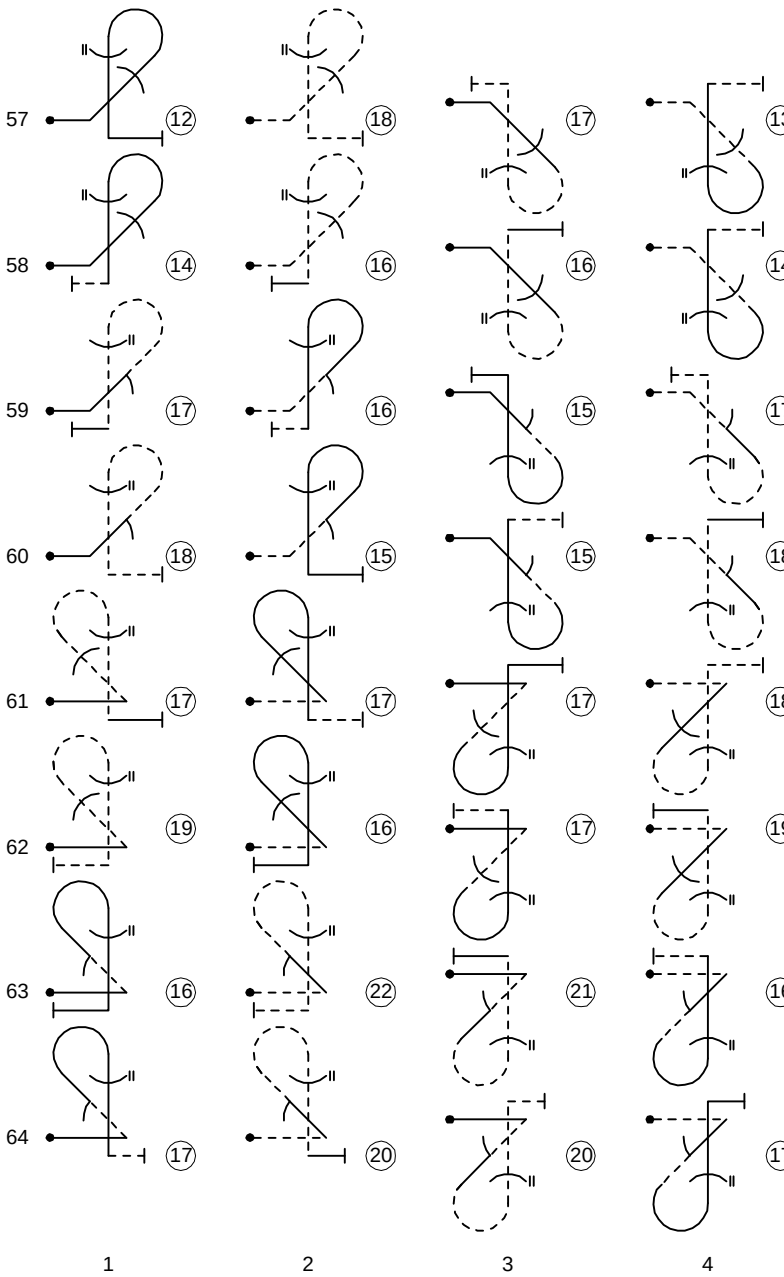
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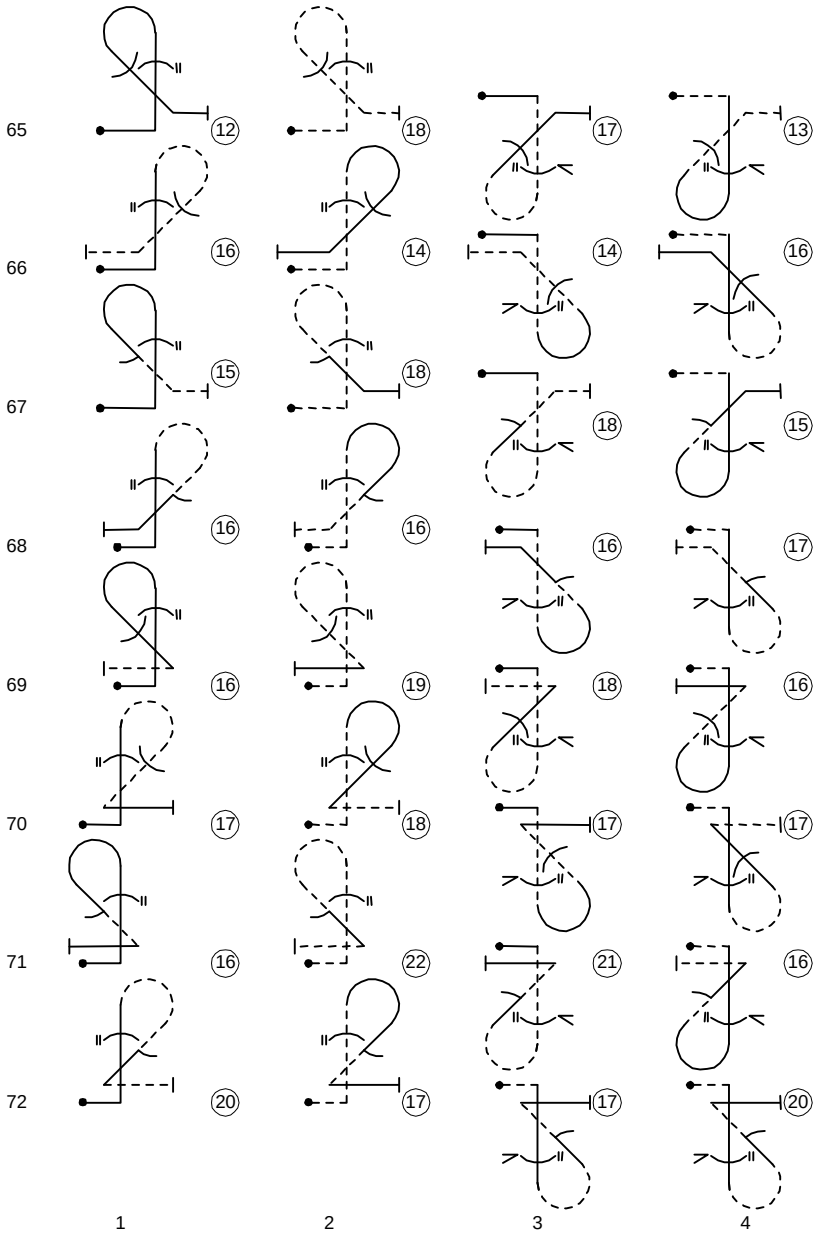
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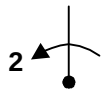
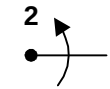
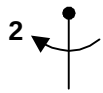
9. ROLLS AND SPINS

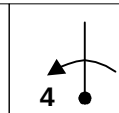
FAMILY 9.1 (SLOW ROLLS)

9.1		¼	½	¾	**1**	**1¼**	**1½**	**1¾**	**2**
1		6	8	10	12	14	15	17	18
2		4	6	8	10	11	12	14	15
3		2	4	6	8	9	10	11	12
4		2	4	6	8	9	10	11	12
5		2	4	6	8	9	10	11	12
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**

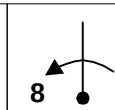
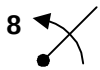
FAMILY 9.2 (2-POINT ROLLS)

9.2					**1**		**1½**		**2**
1					13		17		21
2					11		14		18
3					9		12		15
4					9		12		15
5					9		12		15
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**

FAMILY 9.4 (4-POINT ROLLS)

9.4			**½**	**¾**	**1**	**1¼**	**1½**	**1¾**	**2**
1			9	12	15	18	20	23	25
2			7	10	13	15	17	20	22
3			5	8	11	13	15	17	19
4			5	8	11	13	15	17	19
5			5	8	11	13	15	17	19
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**

9.8 FAMILY 9.8 (8-POINT ROLLS)

9.8		¼	½	¾	1	1¼	1½	1¾	2
1		7	11	15	19	23	26	30	33
2		5	9	13	17	20	23	27	30
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4		3	7	11	15	18	21	24	27
5		3	7	11	15	18	21	24	27
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**

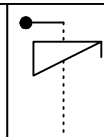
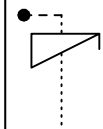
FAMILY 9.9 (POSITIVE FLICK ROLLS)

9.9			½	¾	**1**	1¼	1½	1¾	**2**
1			15	15	15	17	19	21	23
2			13	13	13	15	16	18	20
3			11	11	11	13	14	16	17
4			11	11	11	13	14	16	17
5			11	11	11	13	14	16	17
6			17	17	17	20	22	24	26
7			15	15	15	17	19	21	23
8			13	13	13	15	16	18	20
9			13	13	13	15	16	18	20
10			13	13	13	15	16	18	20
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**

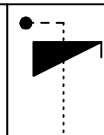
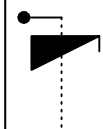
FAMILY 9.10 (NEGATIVE FLICK ROLLS)

9.10			½	¾	1	1¼	1½	1¾	2
1			17	17	17	20	22	24	26
2			15	15	15	17	19	21	23
3			13	13	13	15	16	18	20
4			13	13	13	15	16	18	20
5			13	13	13	15	16	18	20
6			19	19	19	22	24	27	29
7			17	17	17	19	21	24	26
8			15	15	15	17	19	21	23
9			15	15	15	17	19	21	23
10			15	15	15	17	19	21	23
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**

FAMILY 9.11 (POSITIVE SPINS)

					1	1¼	1½	1¾	2
1		Upright Entry Line			5	4	3	3	3
2		Inverted Entry Line			6	5	4	4	4
					4	5	6	7	8

FAMILY 9.12 (NEGATIVE SPINS)

					1	1¼	1½	1¾	2
1		Inverted Entry Line			7	6	5	5	5
2		Upright Entry Line			8	7	6	6	6
					4	5	6	7	8

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